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2nd EDITION

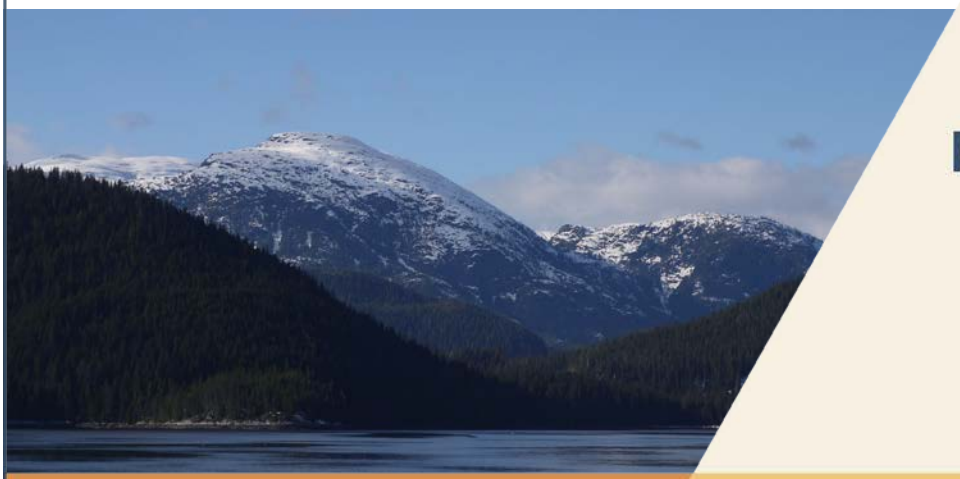
CANADIAN GEOSCIENCE MAP 275

MARINE GEOLOGY

GEOMORPHOLOGY OF THE KITIMAT FIORD SYSTEM

British Columbia

Parts of NTS 103-A, NTS 103-H, and NTS 103-I



Map Information Document

Preliminary

Geological Survey of Canada
Canadian Geoscience Maps

2016

Canada

MAP NUMBER

Natural Resources Canada, Geological Survey of Canada
Canadian Geoscience Map 275 (Preliminary, 2nd Edition)

TITLE

Marine geology, Geomorphology of the Kitimat fiord system, British Columbia, Parts of NTS 103-A, NTS 103-H, and NTS 103-I

SCALE

1:200 000

CATALOGUE INFORMATION

Catalogue No. M183-1/275-1-2016E-PDF
ISBN 978-0-660-05580-0
doi:10.4095/298793

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RECOMMENDED CITATION

Shaw, J. and Lintern, G., 2016. Marine geology, Geomorphology of the Kitimat fiord system, British Columbia, Parts of NTS 103-A, NTS 103-H, and NTS 103-I; Geological Survey of Canada, Canadian Geoscience Map 275 (2nd edition, preliminary), scale 1:200 000. doi:10.4095/298793

ABSTRACT
This map depicts the geomorphology of the Kitimat fiord system, British Columbia, and is based on bathymetry and backscatter data from multibeam sonar surveys, complemented by 3.5 kHz sub-bottom profiler data, grab samples, cores, and bottom photographs. The coverage extends from the head of Kitimat Arm to Hecate Strait, and includes Douglas Channel. The seafloor is divided into classes based on morphology and texture. The classes include glacial landforms that record the advance and retreat of grounded ice, and a wide range of submarine slope failures. The map also shows that postglacial sediment distribution on the fiord floors is highly variable: large areas are current-scoured, so that underlying glaciomarine sediments are exposed. More than a hundred submarine fans deltas are present within the fiords.

RÉSUMÉ
Cette carte illustre la géomorphologie du système de fjords de Kitimat, en Colombie-Britannique, et elle est fondée sur des données bathymétriques et des données de rétrodiffusion acquises lors de levés au sonar multifaisceaux, auxquelles s'ajoutent des données recueillies à l'aide d'un sondeur de sédiments à fréquence d'émission de 3,5 kHz, des échantillons prélevés par benne, des carottes et des photographies du fond marin. La zone couverte s'étend du fond du bras Kitimat au détroit d'Hecate et comprend le chenal Douglas. Le fond marin est divisé en classes selon la morphologie et la texture. Les classes englobent des reliefs glaciaires qui témoignent de l'avancée et du recul de la glace ancrée, ainsi qu'une vaste gamme de ruptures sous-marines de versant. La carte illustre également la répartition très variable des sédiments postglaciaires sur le fond des fjords : de vastes zones ont été érodées par les courants, ce qui a permis d'exposer les sédiments glaciomarins sous jacents. Plus d'une centaine d'éventails deltaïques sous-marins sont présents dans les fjords.

SHEET 1 OF 1, MARINE GEOLOGY

GENERAL INFORMATION
Authors: J. Shaw and D.G. Lintern

Geological compilation by J. Shaw

Cartography by S. Hayward and E. Everett

Map projection Universal Transverse Mercator, zone 9.

North American Datum 1983

Base map at the scale of 1:250 000 from Natural Resources Canada, with modifications.

Shaded relief image derived from the Canadian Digital Elevation Data (CDED) digital elevation model supplied by Canada Centre for Mapping and Earth Observation Illumination: azimuth 345°, altitude 45°, vertical factor 10x

Mean magnetic declination 2016, 18°22'E, decreasing 12.8' annually. Readings vary from 18°37'E in the NW corner to 18°06'E in the SE corner of the map.

This map is not to be used for navigational purposes.

Title photograph: Snow covered hills near Douglas Channel, British Columbia. Photograph by J. Shaw. 2016-001

The Geological Survey of Canada welcomes corrections or additional information from users.

Data may include additional observations not portrayed on this map.
See documentation accompanying the data.

This publication is available for free download through
GEOSCAN (http://geoscan.nrcan.gc.ca/).

Preliminary publications in this series have not been scientifically edited.

Map Viewing Files

The published map is distributed as a Portable Document File (PDF), and may contain a subset of the overall geological data for legibility reasons at the publication scale.

Descriptive Notes

STUDY AREA

Douglas Channel (Fig. 1) is part of the Kitimat fiord system that dissects the Coast Range of northern British Columbia, Canada (Macdonald et al., 1983). This map encompasses not only the fiord system but also parts of the adjacent continental shelf (Hecate Strait).

RECENT GEOLOGICAL HISTORY

About 15,000 to 14,000 years ago the region was covered by glacial ice that flowed to the southwest in Hecate Strait and thence into Moresby Trough (Barrie and Conway, 1999; Clague and James, 2002). Streamlined landforms developed under the grounded ice on the continental shelf, just outside the fiords. As deglaciation progressed, meltwater plumes deposited a blanket of glaciomarine silt outside the fiords. Icebergs impacted this unit, creating furrows and pits.

As the ice retreated inland, thick deposits of glaciomarine mud formed in fiord basins. Transverse moraines formed during halts in glacier retreat. Following further retreat, glaciomarine silt on top of these moraines failed in several places, notably at the south end of Squally Channel and at Kitkiata.

MODERN PROCESSES

The Kitimat fiord system is subject to high precipitation and high rates of snowpack melt. The region is seismically active, although less so than farther offshore, near the transform Queen Charlotte Fault (Rohr and Tryon, 2010). Several recent publications describe the extent to which mass transport processes have conditioned the seafloor (e.g. Conway et al., 2012, 2013). The preliminary evaluation of the evidence suggests that mass transport has occurred throughout the postglacial period, and continued to the modern day, as evidenced by the 1970s slope failures at Kitimat (Prior et al., 1983).

Strong bottom currents impact the fiord floors in some areas, creating alternating areas of scour and high sedimentation rate (Bornhold, 1983). Large deltas are found at the head of the fiord system, at Kitimat and Kitkiata, while numerous smaller, fan deltas (Prior and Bornhold, 1989, 1990) are found through the area, preferentially located in the upper fiord system.

The recent surveys have located reefs composed of glass sponges (Hexactinellida) within the fiord system. They have developed on 'hard' glacial substrates, as elsewhere in the fiords of the Pacific Northwest (*see* Stone et al., 2014).

MAPPING APPROACH

The area was mapped by the Canadian Hydrographic Service using Kongsberg Maritime multibeam sonar systems that provide high-resolution bathymetry of the sea floor as well as **"**backscatter strength**"**, a derived attribute that correlates with sediment type at the seafloor. Figure 2 shows the distribution of backscatter strength in the fiord system. Other information used for mapping was derived from sub-bottom profiles, grab samples, piston cores, and bottom photographs.

The approach is similar to that of "seascape mapping" (e.g. Shaw et al., 2012) in which it assumed that the seafloor can be mapped in terms of units, each unit having a distinct combination of morphology, texture, and biota. However, it was felt that there were insufficient bottom photographs to adopt the exact same approach in the Douglas Channel region, so the seascape map units described here are essentially geomorphology and texture.

SEASCAPES OUTSIDE THE FIORDS

The seascapes are divided into two classes: those on the inner continental shelf outside the fiords, and those within the fiords. Outside the fiords bedrock is commonly exposed. Streamlined landforms were formed parallel to ice-flow direction. Moraines record temporary halts in the incremental retreat of grounded ice, and were formed normal to ice flow direction. Glaciomarine sediments were deposited by fallout from meltwater plumes, and were subsequently turbated by icebergs. Deposits of postglacial mud/sandy mud are found in areas of low current activity, while areas of

winnowed/scoured seafloor, probably underlain by glaciomarine sediment, occur where currents are relatively strong.

FIORD SEASCAPES

Thirteen seascape classes are designated for the fiords. Fiord sidewalls consist of either bedrock or unconsolidated sediment, the latter consisting of a blanket of glaciomarine mud, with or without a cover of postglacial mud. Fiord floors are divided into either banks of postglacial mud up to 90 m thick, gas-charged in places, or areas of scour and winnowing, where underlying glaciomarine sediments are exposed at the sea floor under surface gravel lags. Figure 3 shows the differing acoustic character of these two seascapes at the south end of Douglas Channel. Moraines are located transverse to fiord axes, and consist of thick deposits of glacial diamict capped by glaciomarine mud. Deltas are grouped into two types: 1) large deltas at Kitimat and Kildala; and 2) the numerous fan deltas that form cone-shaped deposits banked against fiord sidewalls. Mass transport deposits are grouped as: 1) large, complex failures of probable Late Glacial age on the rear slopes of moraines; 2) debris flows and translational slides; 3) bedrock slump/rock avalanche; and 4) bedrock creep (i.e. sackung, Ambrosi and Crosta, 2006). One area of bioherms was mapped, and an area of anthropogenic disturbance was identified. The map also shows the distribution of pockmarks and gas masking. Figure 4 is a coloured, shaded relief image of an area at the south end of Devastation Channel (location on main map) showing several of the seascape types within the fiords. Figure 5 shows backscatter strength for the same area.

POSTGLACIAL SEDIMENTATION

Figure 6 shows the thickness of postglacial sediment (mud and sandy mud) in the fiord system. Relatively thick deposits (> 50 m) occur at the heads of the fiords, in the Kitimat area. Maximum thicknesses (up to ~ 90 m) are found in a series of depocentres in the Whale Channel/southern Douglas Channel area. Figure 3 shows how the depocentres are commonly located in close proximity to scoured areas.

ACKNOWLEDGMENTS

This work was part of a project managed by Dr. Gwyn Lintern under the aegis of Natural Resources Canada's Public Safety Geoscience Program. Robert Kung created and managed the ArcGIS project that contained multibeam bathymetry, backscatter strength, and other data sets. Scott Hayward processed GIS data in Dartmouth. Brian J. Todd reviewed the map and provided valuable advice.

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ADDITIONAL INFORMATION

The Additional Information folder of this product's digital download contains figures that appear in the map surround.
- PDF of each figure/table that appears in the CGM surround.

Author Contact

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Coordinate System

Projection: Universal Transverse Mercator
Units: metres
Zone: 9
Horizontal Datum: NAD83
Vertical Datum: mean sea level

Bounding Coordinates

Western longitude: 130°00’00”W
Eastern longitude: 128°25’00”W
Northern latitude: 54°05’00”N
Southern latitude: 52°30’00”N

Software Version

Data has been originally compiled and formatted for use with ArcGIS™ desktop version 10.1 developed by ESRI®.

Data Model Information

No Model

This Canadian Geoscience Map does not conform to either the Bedrock or Surficial Mapping Geodatabase Data Models. The author may have included a complete description of the feature classes and attributes in the Data\Data Model Info folder.